

touch panel has been selected or touched. Computer 906, which can be any general purpose computer operating under the control of suitable software and for firmware, is coupled to amplifier 922 via connection 928 and instructs amplifier 922 to provide input current to the actuator 924 over connection 930. Upon receipt of an instruction from the computer 906, amplifier 922 provides an input current to the actuator 924 via connection 930. Actuator 924 provides a haptic sensation or effect to the touch-sensitive panel 918. The processor 906 (or, potentially, another device (not shown)) provides a display image or image to display device 914.

[0134] Turning finally to FIGS. 29, 30 and 31, these figures illustrate how areas of a touch pad and/or a touch screen or other similar touch input device may be utilized. In each of the figures areas of the touch sensitive surface of the touch input device are associated with particular inputs. In FIG. 29, a “+” area and a “-” area are provided. This could be used, for example, to zoom in (+) or zoom out (-) in a graphical environment having a pictorial representation of an image. FIG. 30 illustrates a version with “+X”, “-X”, “+Y” and “-Y” which could be used to translate an object or to rotate an object, or to otherwise interact with a graphically depicted object, as desired. Finally, FIG. 31 provides a similar arrangement to that shown in FIG. 30, however, intermediate values (e.g., some -X and some +Y at the same time) may be input in an intuitive manner. In some embodiments, these areas along with some indication as to what they are intended to control at a given point in time may be displayed on a touch screen and haptic feedback provided to the user indicative of rates of input, boundaries and similar conditions in the graphical environment, and the like.

[0135] While this invention has been described in terms of several preferred embodiments, it is contemplated that alterations, permutations, and equivalents thereof will become apparent to those skilled in the art upon a reading of the specification and study of the drawings. For example, many different types of actuators can be used to output tactile sensations to the user. Furthermore, many of the features described in one embodiment can be used interchangeably with other embodiments. Furthermore, certain terminology has been used for the purposes of descriptive clarity, and not to limit the present invention. The invention, therefore, is not to be restricted except in the spirit of the appended claims.

What is claimed is:

1. A method for simulating a button press using haptic feedback imparted through a touch surface, comprising:

sensing a contact with said touch surface; and

moving the touch surface responsive to said contact in accordance with a first single-discontinuity waveform.

2. The method of claim 1, wherein moving comprises:

generating a first signal in response to contact;

transmitting the first signal to a processor;

creating a haptic output current signal in response to said first signal;

carrying said haptic output current signal to an actuator arranged to create relative motion between a first structural element and a second structural element thereof, the first structural element mechanically

coupled to the touch surface and the second structural element mechanically coupled to a display device or a housing structure; and

causing a haptic effect by actuating the actuator.

3. A method of claim 1, wherein moving comprises:

generating a first signal in response to the contact;

transmitting the first signal to a processor;

creating a haptic output current signal in response to said first signal;

carrying said haptic output current signal to an actuator arranged to create relative motion between a first structural element and a second structural element thereof, the first structural element mechanically coupled to the touch-sensitive panel and the second structural element mechanically coupled to a display device or a housing, wherein the actuator further includes:

a first biasing element coupling the first structural element to the second structural element;

a first magnetic device carried by the first structural element, the first magnetic device including a first pole piece;

a second magnetic device carried by the second structural element, the second magnetic device including a second pole piece; and

a first coil disposed about at least one of said first pole piece and said second pole piece;

wherein the first biasing element is arranged to provide a biasing force opposing an attractive magnetic force urging the first and second pole pieces together when current is applied to the first coil; and

causing a haptic effect by actuating the actuator.

4. The method of claim 1, wherein the single-discontinuity waveform is associated with one of a button press or a button release.

5. The method of claim 4, further comprising moving the touch surface in accordance with a second single-continuity waveform associated with the other of the button press or the button release.

6. The method of claim 5, wherein the first second single-continuity waveforms are different from one another.

7. The method of claim 5, wherein the first second single-continuity waveforms are substantially identical to one another.

8. The method of claim 1, wherein the single-discontinuity waveform is symmetrical.

9. The method of claim 1, wherein the single-discontinuity waveform is asymmetrical.

10. The method of claim 1, wherein the touch surface is a touchscreen.

11. The method of claim 1, wherein the touch surface is a touchpad.

12. The method of claim 1, wherein said contact is effected by a body portion of an operator.

13. The method of claim 1, wherein said contact is effected by a stylus manipulated by an operator.

14. A method for providing haptic feedback representative of the relative location of a cursor and a graphical object displayed on a display screen, comprising: